

# Winter 2009/2010 Climate Summary For Southwest Lower Michigan

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The 2009/2010 winter season over Southwest Lower Michigan featured near normal temperatures and below normal precipitation (Table 1). Snowfall was above normal near and south of Interstate 96, near normal between Interstate 96 and Route 10 and below normal north of Route 10.

Our winter forecast stated: *“The National Weather Service 2009-2010 winter forecast for Southwest Lower Michigan has an equal chance for the temperature and snowfall to be above normal, near normal or below normal. Precipitation is expected to be below normal.”* As expected, the typical warm tendency of a moderate to strong El Niño was offset by other factors. Similarly, the below normal snowfall associated with a moderate to strong El Niño was offset by other factors. The below normal precipitation aspect of a moderate to strong El Niño did turn out as forecast.

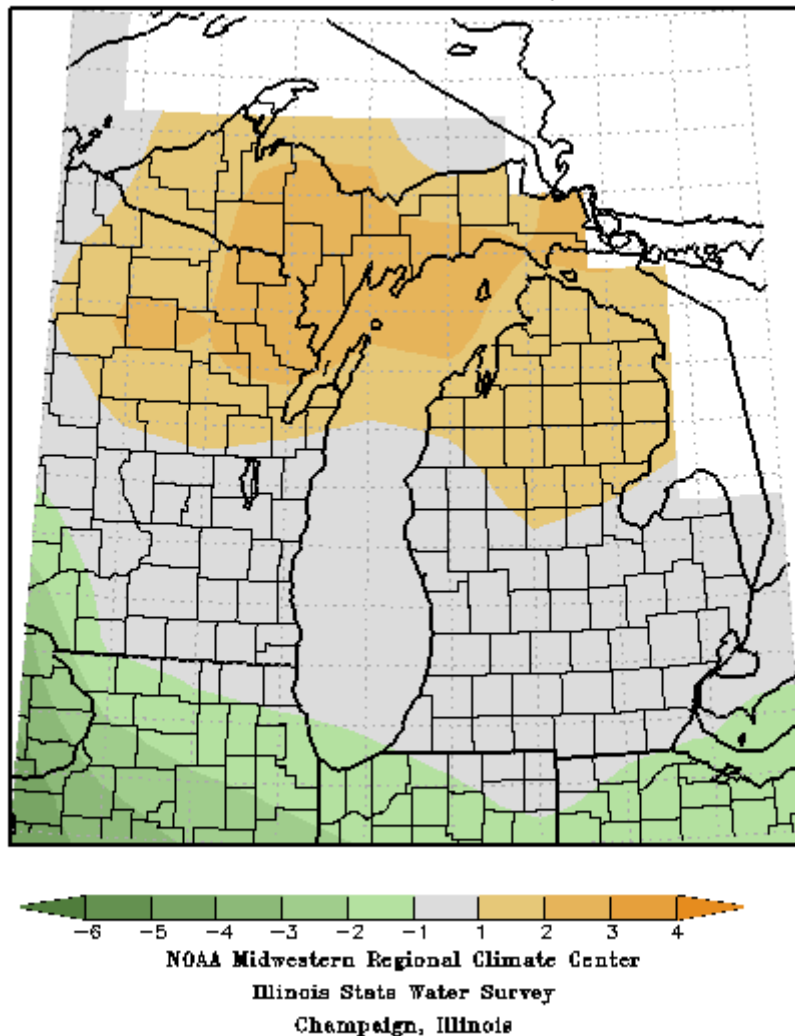
**TABLE 1. The reported temperature and precipitation for the winter of 2009/2010 at selected climate stations in Southwest Lower Michigan. Normals are computed from 30-year averages from 1971-2000.**

Location		Temperature (F)	Precipitation (inches)	Snowfall (inches)
Grand Rapids	<i>Reported</i>	26.7°	5.64	69.5
	<i>Normal</i>	25.0°	6.27	52.1
	<i>Departure</i>	+1.7°	-0.63	+17.4
Lansing	<i>Reported</i>	25.1°	3.73	41.2
	<i>Normal</i>	24.2°	5.23	37.8
	<i>Departure</i>	+0.9°	-1.50	+3.6
Muskegon	<i>Reported</i>	27.0°	6.36	73.2
	<i>Normal</i>	25.8°	6.44	82.0
	<i>Departure</i>	+1.2°	-0.08	-8.8

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Average Temperature Departure from Mean in Degrees F  
December 1, 2009 to February 28, 2010



**Figure 1. The winter 2009/2010 daily mean temperature departure from normal for Michigan.**

The area averaged winter mean temperature was 25.2°F, which is 0.4°F warmer than the 1971 to 2000 normal. Figure 1 displays mostly near normal temperatures (within 1° of normal) over the Grand Rapids County Warning Area (CWA). The warmest departures were over the northeast CWA, where average temperatures were as high as 1° above normal. The National Climatic Data Center (NCDC) state ranking map (Figure 2) reveals the state of Michigan ranked 80<sup>th</sup> out of 115 years, which puts Michigan in the above normal category for this winter. Figure 1 suggests that the above normal state ranking was due to above normal temperatures in Upper Michigan and Northern Lower Michigan. This suggestion is supported by the divisional ranking from NCDC for the winter of 2009/2010 (Figure 3).

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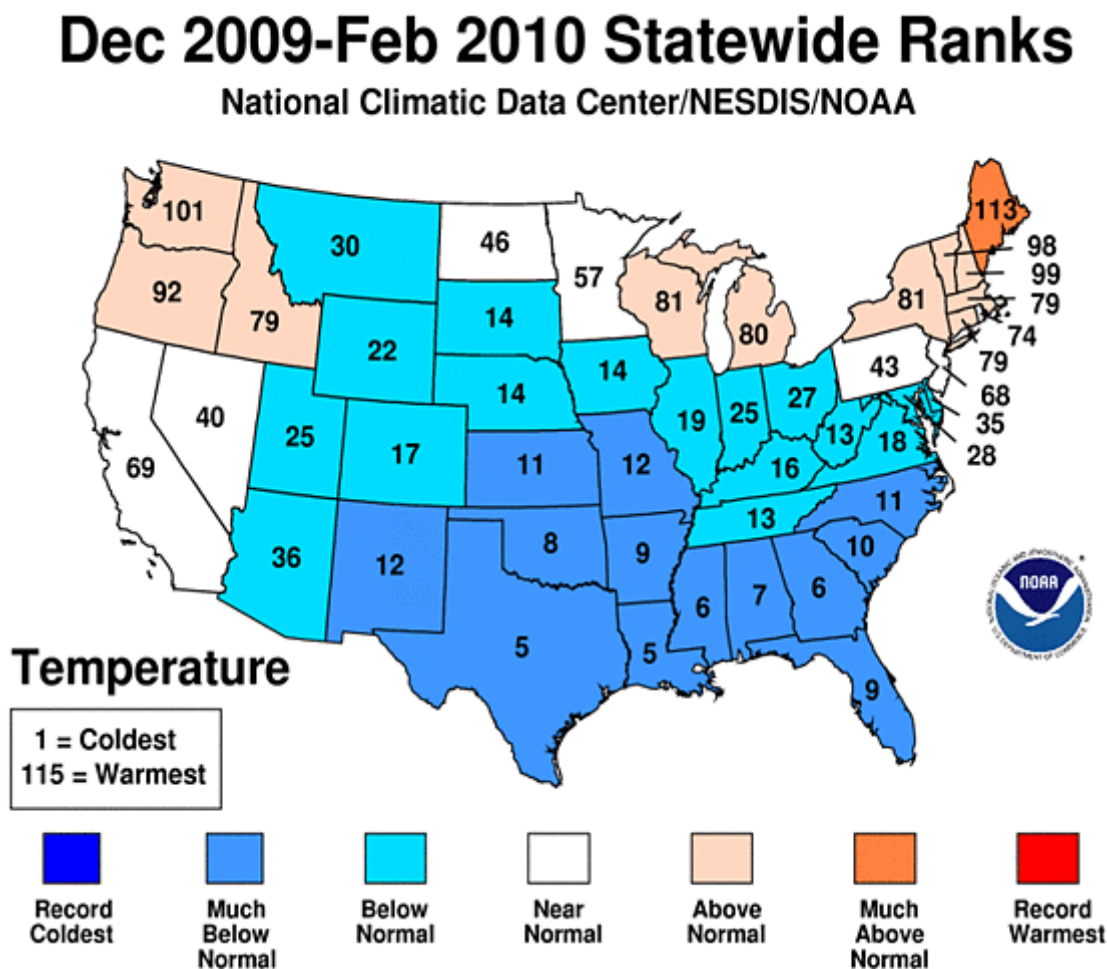


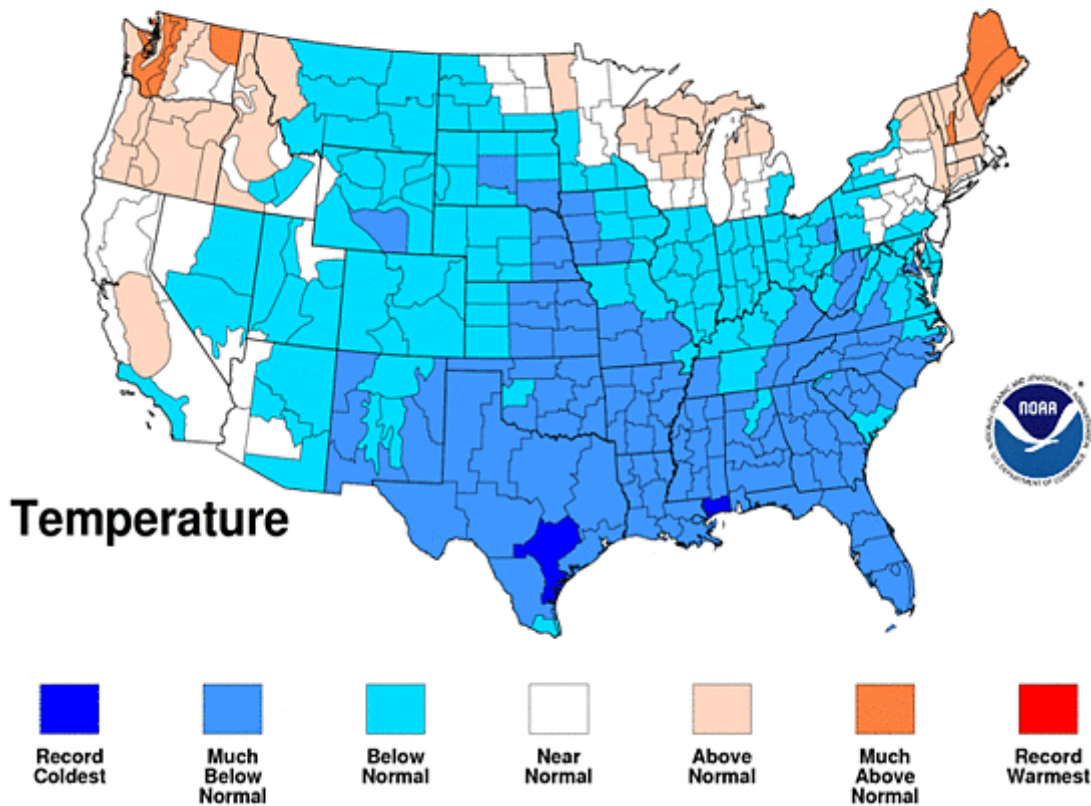
Figure 2. The winter 2009/2010 statewide temperature ranks for the lower 48 states.

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## Dec 2009 - Feb 2010 Divisional Ranks

National Climatic Data Center/NESDIS/NOAA



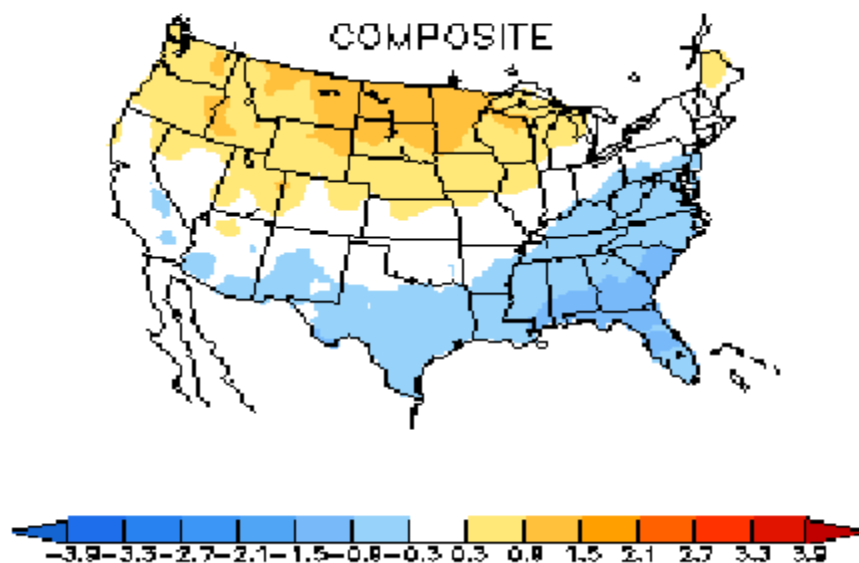
**Figure 3. State climate divisional ranks for the winter of 2009/2010**

El Niño was one of the primary influences for this past winter's weather in combination with an unusually strong negative phase of the Arctic Oscillation. El Niño was forecast to be moderate in strength this winter, but it turned out to be the 5<sup>th</sup> strongest since good records began in 1950. Figure 4 shows the typical impact of El Niño on temperature anomalies for the contiguous United States. Comparing Figs. 1 and 4, it can be seen that the winter of 2009/2010 was similar to the typical impact of an El Niño winter for Michigan.

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## El Nino Winter Composite for Temperature Anomalies Based on 17 Cases

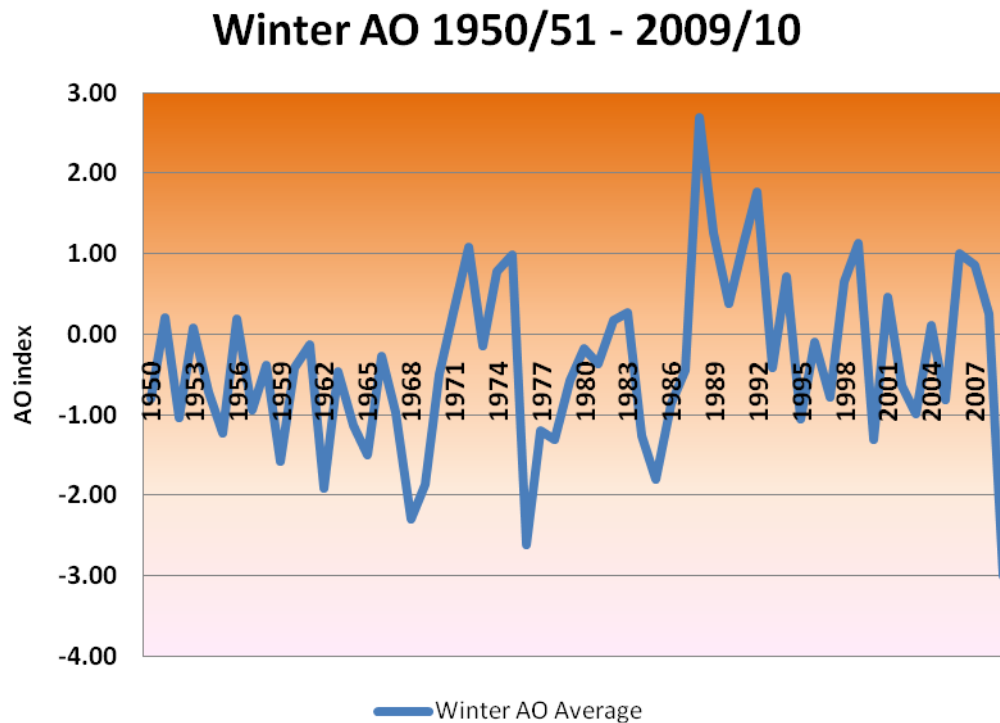


**Figure 4. The El Niño winter composited temperature anomalies based on 17 El Niño events since 1950.**

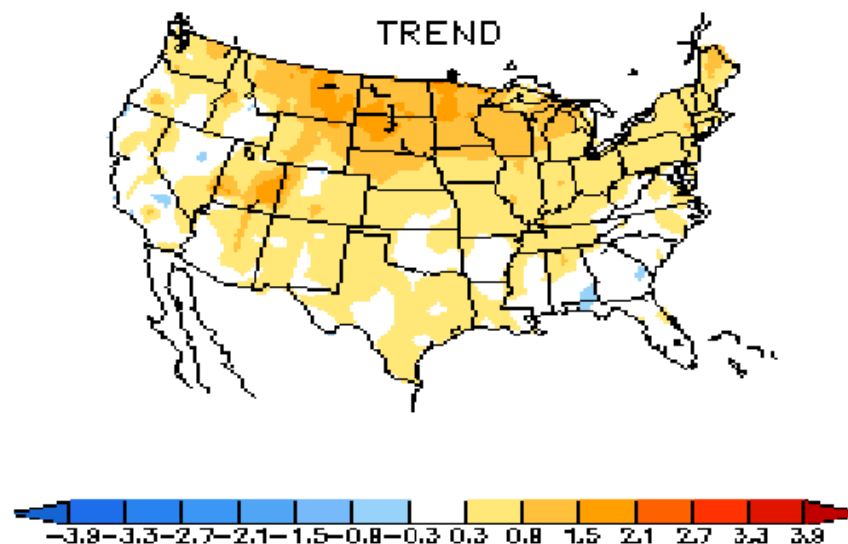
The Arctic Oscillation broke the all time record for being negative this winter (Figure5). The impact of this was for most of the eastern United States to experience below normal temperatures. However, it still was not strong enough to offset the impact of the strong El Niño over Michigan.

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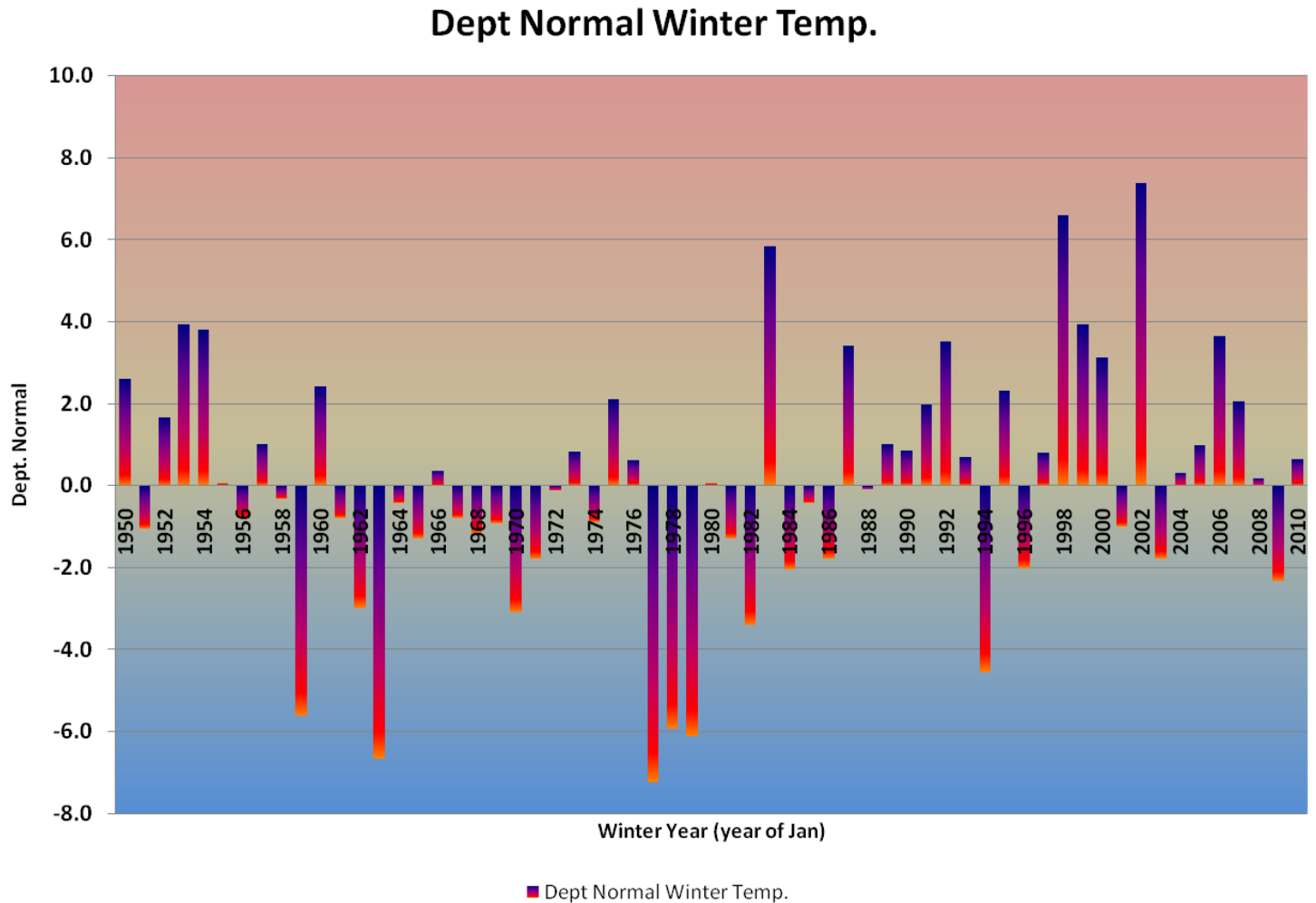
**Figure 5 Arctic Oscillation for the winter months from the winter of 1950/1951 through 2009/2010.**



**Figure 6. Winter (December-February) temperature trend. The trend is the mean temperature over the past ten years (2000-2009) minus the 1971-2000 mean.**

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There has been a trend for warmer winter temperatures for Southwest Lower Michigan over the past 10 years (2000 through 2009) when compared to the 1971-2000 mean (Figure 6). However, the warming trend appears to have slowed down in recent years (Figure 7).

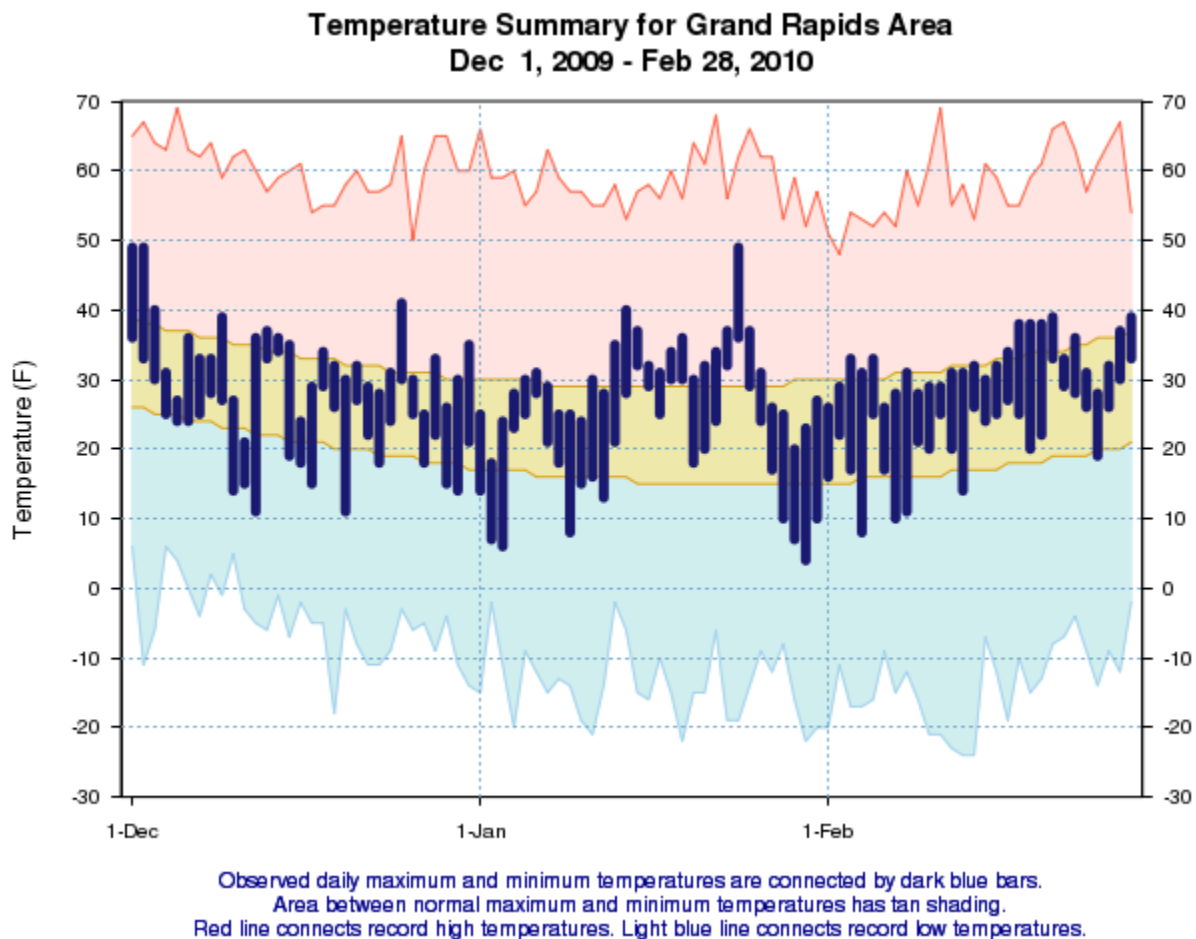


**Figure 7. The graph above shows the winter mean area temperature departure from normal for all of Southwest Lower Michigan, from 1950 through 2010.**

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Figures. 8-10 show the daily temperature anomalies were mostly near to below normal during most of December into early January, then again late in January into mid February. Mid January and the second half of February featured mostly warmer than normal temperatures. One striking feature of these charts is the lack of any real thaw through this winter, which is very unusual. There were very few days with high temperatures exceeding 40°F. That helped to keep snow on the ground most of the winter.

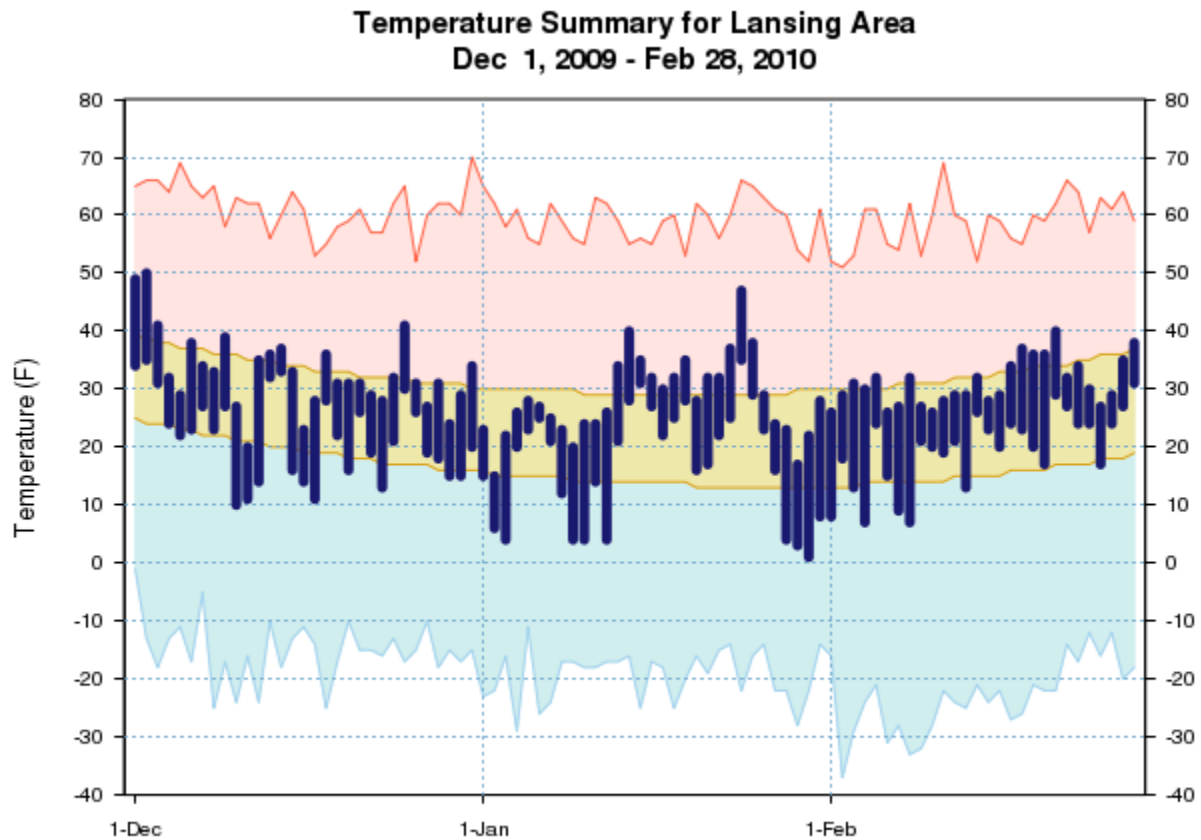


**Figure 8. Winter 2009/2010 daily temperatures for Grand Rapids. The daily maximum and minimum temperatures are connected by dark blue bars. The area between the maximum and minimum temperature has tan shading. Red lines connect the record high temperatures. Blue lines connect the record low temperatures.**



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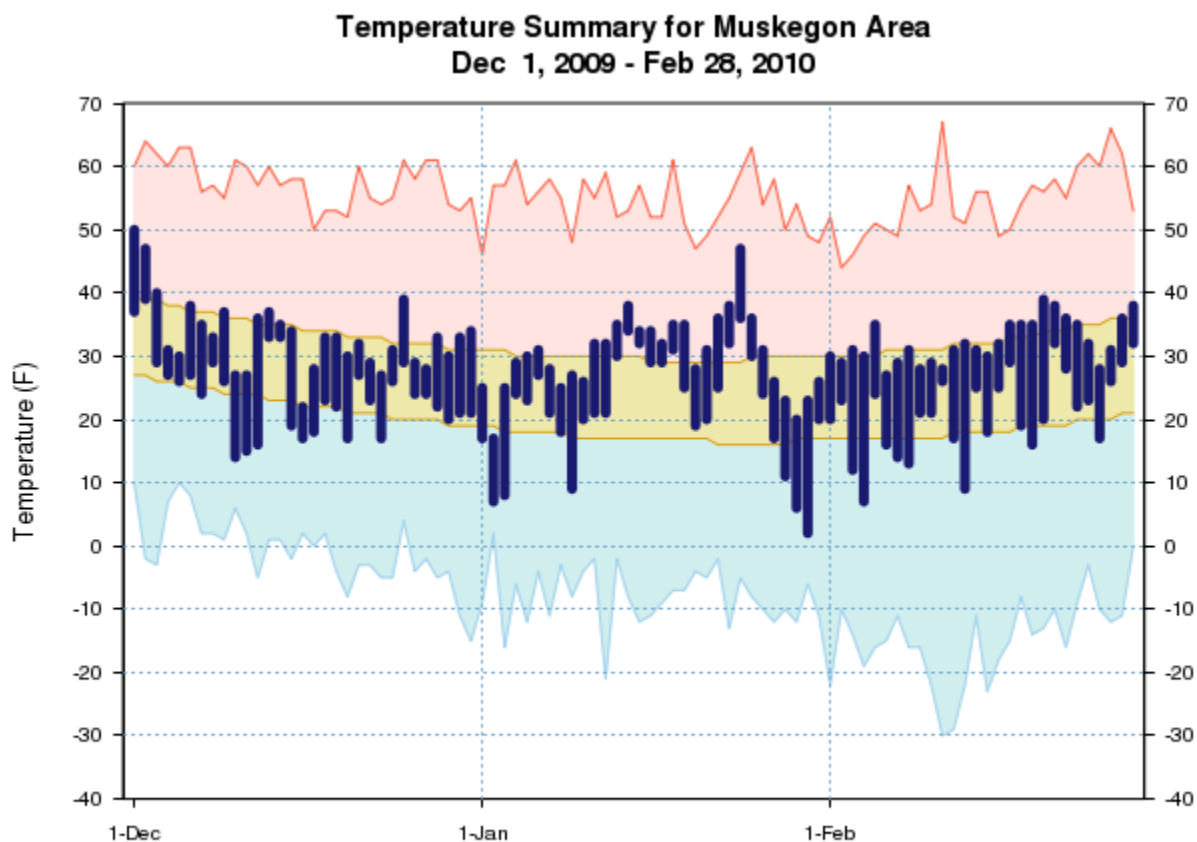


Observed daily maximum and minimum temperatures are connected by dark blue bars.  
Area between normal maximum and minimum temperatures has tan shading.  
Red line connects record high temperatures. Light blue line connects record low temperatures.

**Figure 9. Same as Figure 8, expect for Lansing.**

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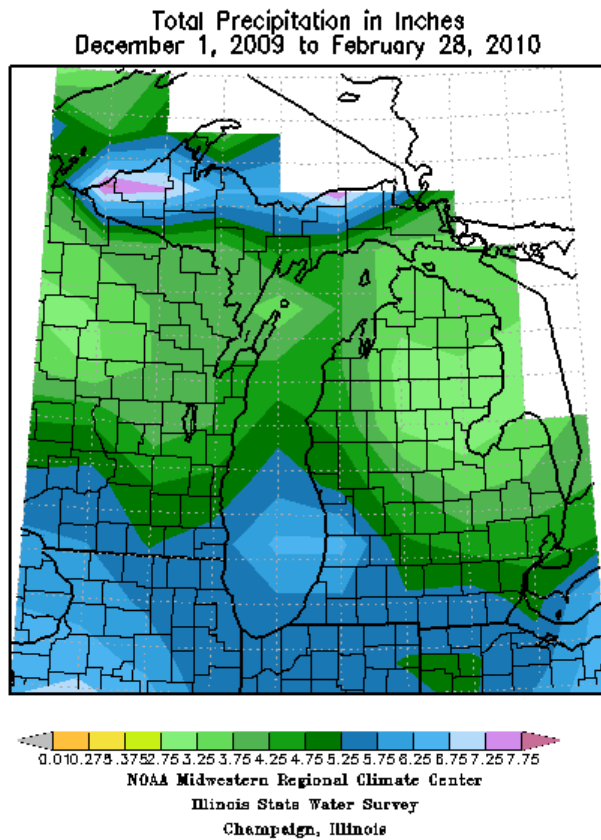
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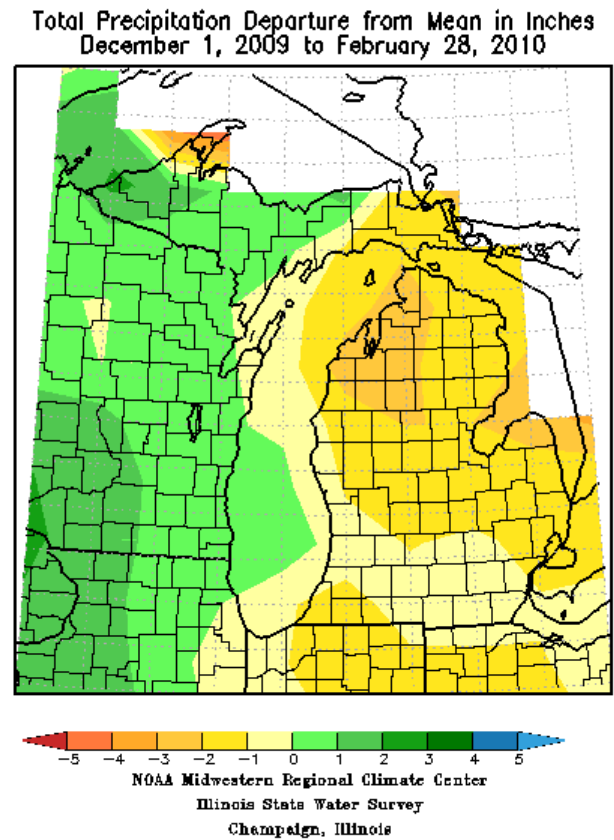
Observed daily maximum and minimum temperatures are connected by dark blue bars.  
Area between normal maximum and minimum temperatures has tan shading.  
Red line connects record high temperatures. Light blue line connects record low temperatures.

**Figure 10. Same as Figure 8, except for Muskegon.**

# Winter 2009/2010 Climate Summary For Southwest Lower Michigan



**Figure 11a**

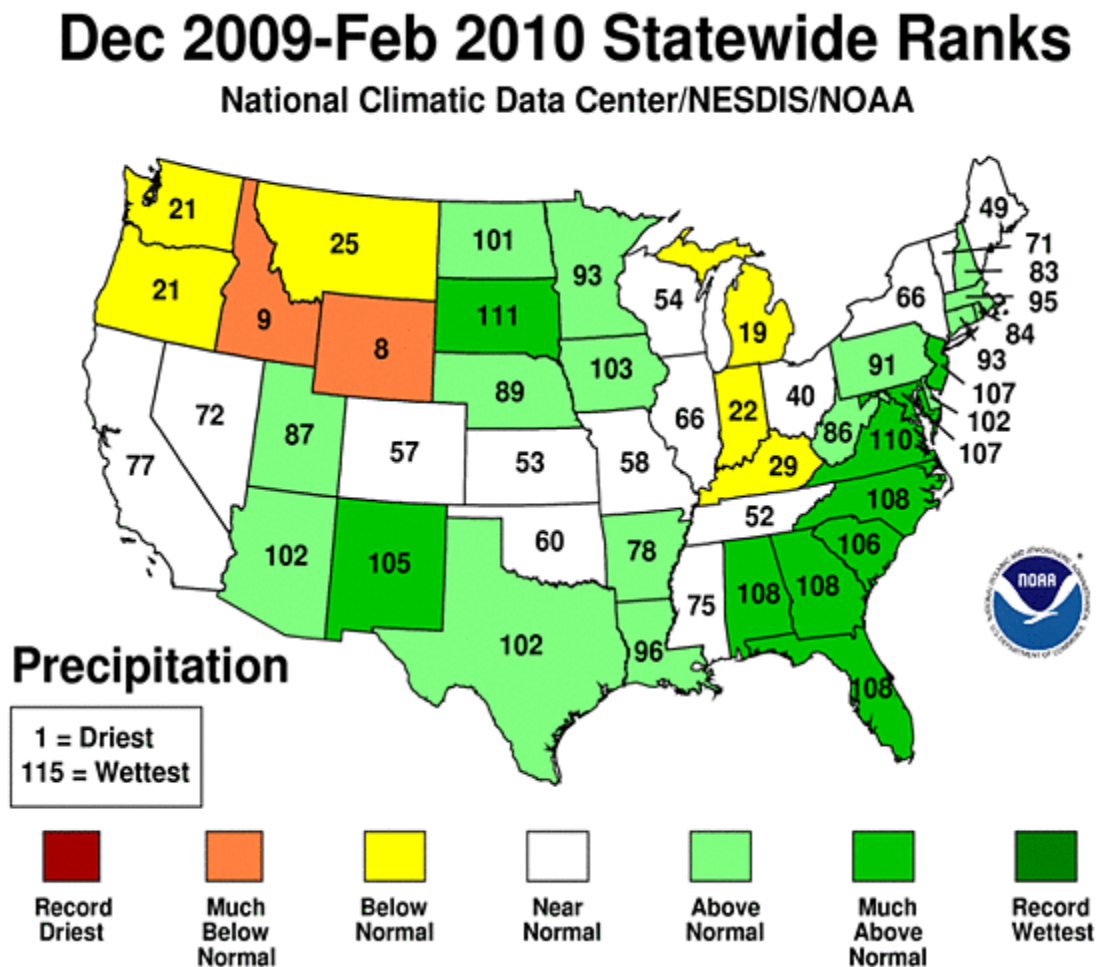


**Figure 11b**

**Figure 11. Total winter precipitation (a) and departure from normal (b) for Michigan.**

The total precipitation ranged from 3.77 inches at Mason in Ingham County to over 7.31 inches at Grandville. Figure 11a shows a fairly widespread coverage of 3 to 6 inch totals. The mean precipitation for Southwest Lower Michigan was 4.49 inches, which is 1.47 inches below normal. Northern areas were around 2 inches below normal while locations closer to I-94 were within an inch of normal (Figure 11b).

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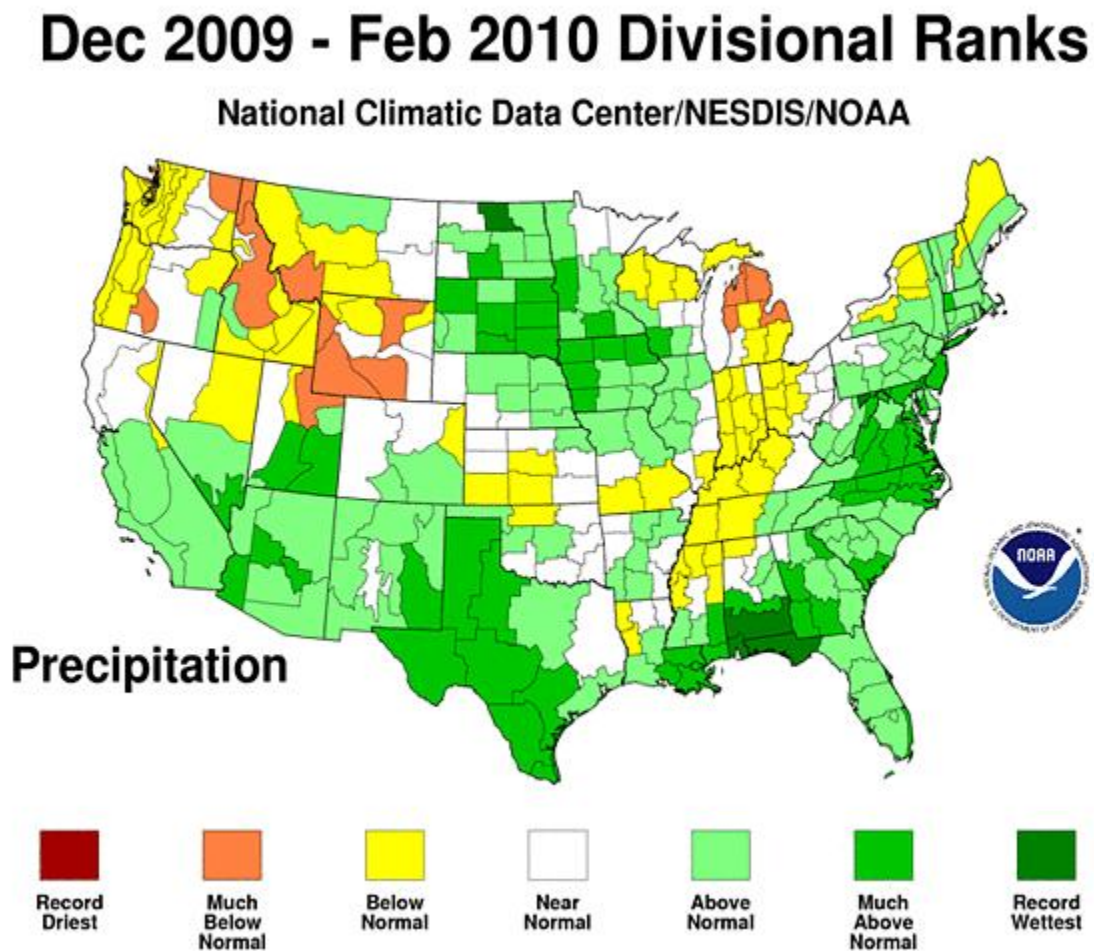


**Figure 12. NCDC winter precipitation departure from the mean for the contiguous United States.**

The state of Michigan experienced the 19<sup>th</sup> driest winter out of 115 years (Figure 12). Looking at the four climate divisions that make up Southwest Lower Michigan (Figure 13), it can be seen that the southwest lake shore was near normal, but the other three climate divisions of Southwest Lower Michigan were in the below normal classification.

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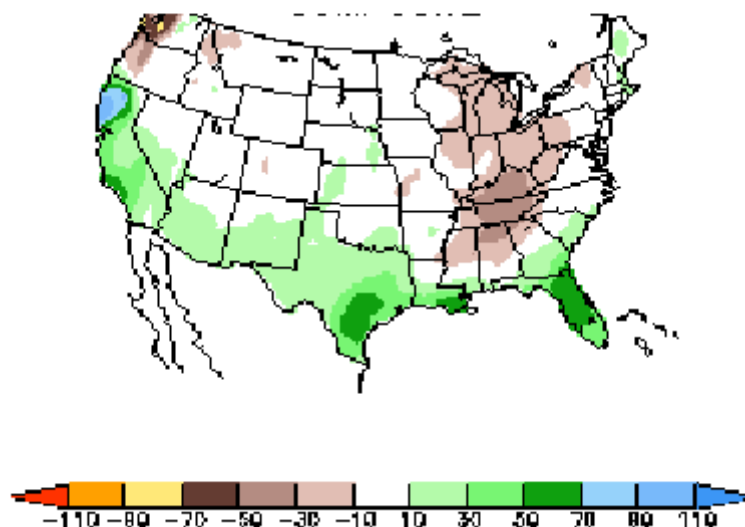


**Figure 13. The winter 2009/2010 divisional precipitation ranks**

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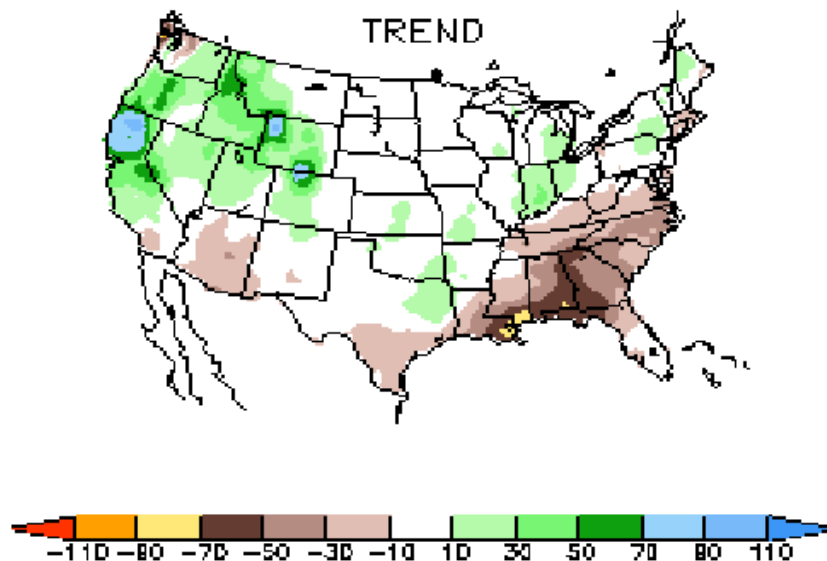
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## El Nino Winter Composite for Precipitation Anomalies Based on 17 Cases



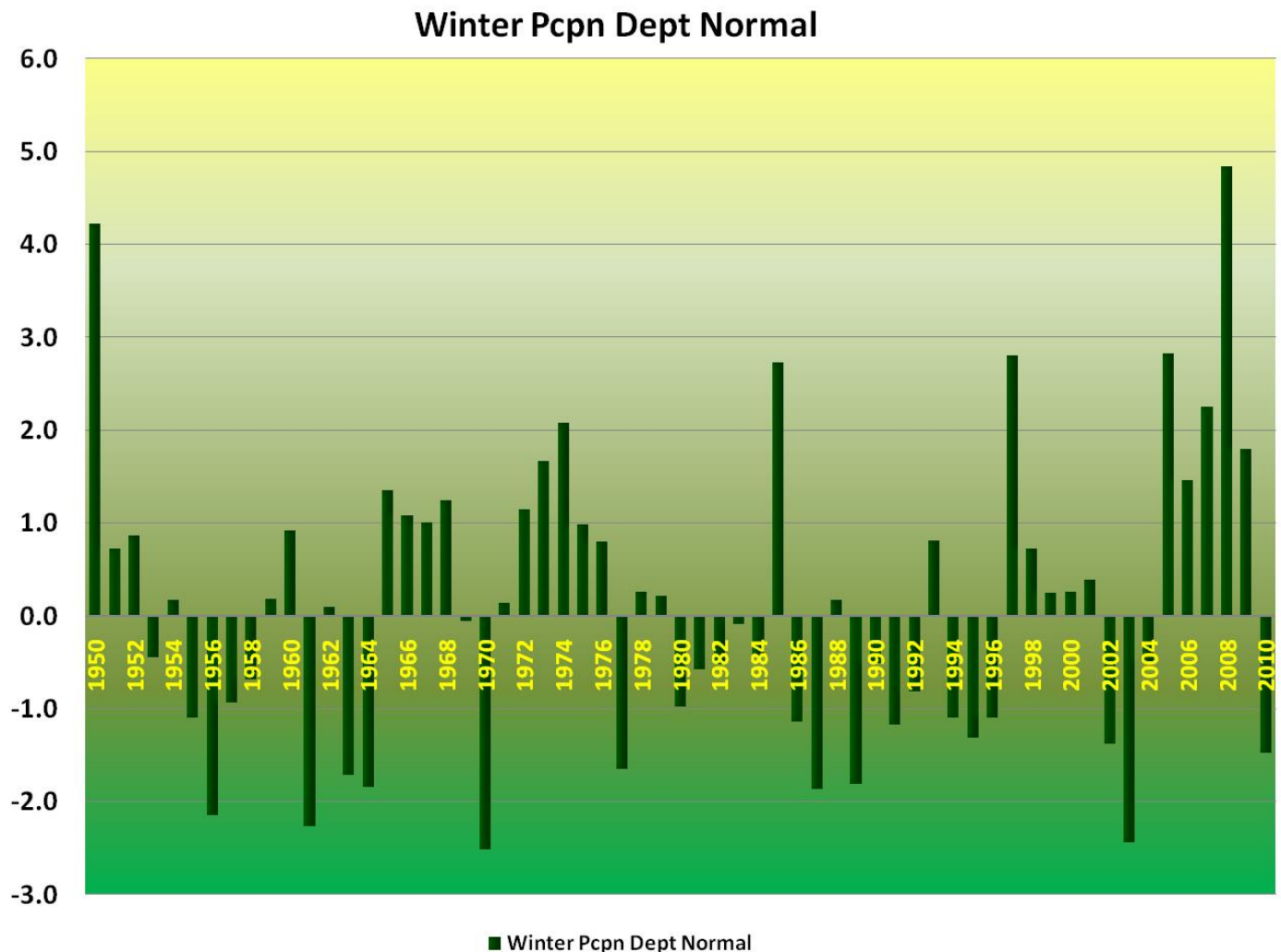
**Figure 14. El Niño winter composites for precipitation using 17 El Niño events since 1950.**

The typical impacts of El Niño precipitation anomalies (Figure 14) were very similar to what occurred this past winter (Figure 12-13). The large area of below normal precipitation from Upper Michigan across Lower Michigan into Ohio this past winter matched the El Niño composites for relative dryness.



**Figure 15 Winter precipitation trend.**

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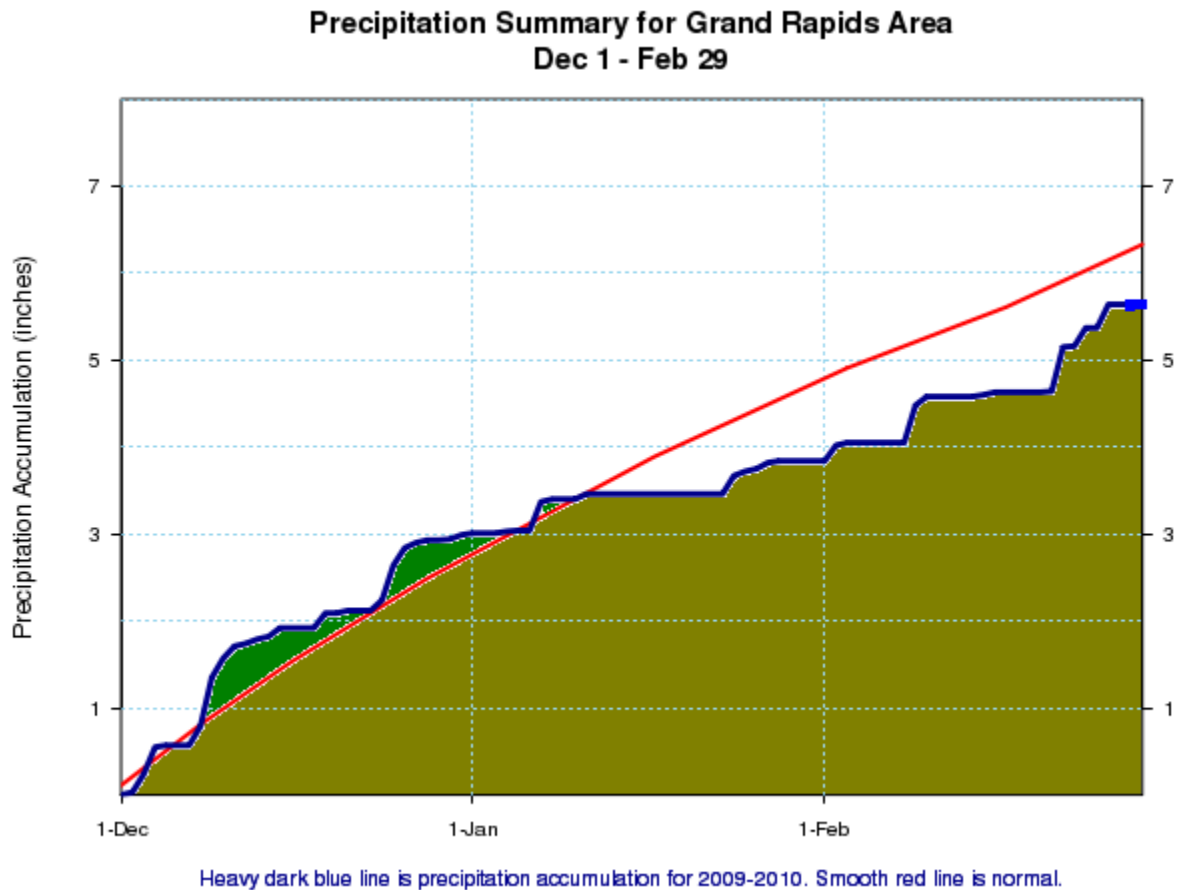
**Figure 16. Total fall precipitation departure from normal for all of Southwest Lower Michigan from 1995 through 2009 (most recent trend period).**

During the past fifteen winters (1996 to 2010), there has been a significant trend toward wetter winters over Southwest Lower Michigan (Figure 16). During that time, seven winters were wetter than normal; four were drier than normal and four winters near normal. The first half of the past 15 years (1996-2002) was mostly drier than normal, whereas the most recent seven years were the wettest winters.

The last time there were so many consecutive wet winters was in the mid 1970s. Most of the winters between 1980 and 2004 were drier than normal. While not shown in the above chart, this approximate 30 year cycle continued through the 20<sup>th</sup> century.

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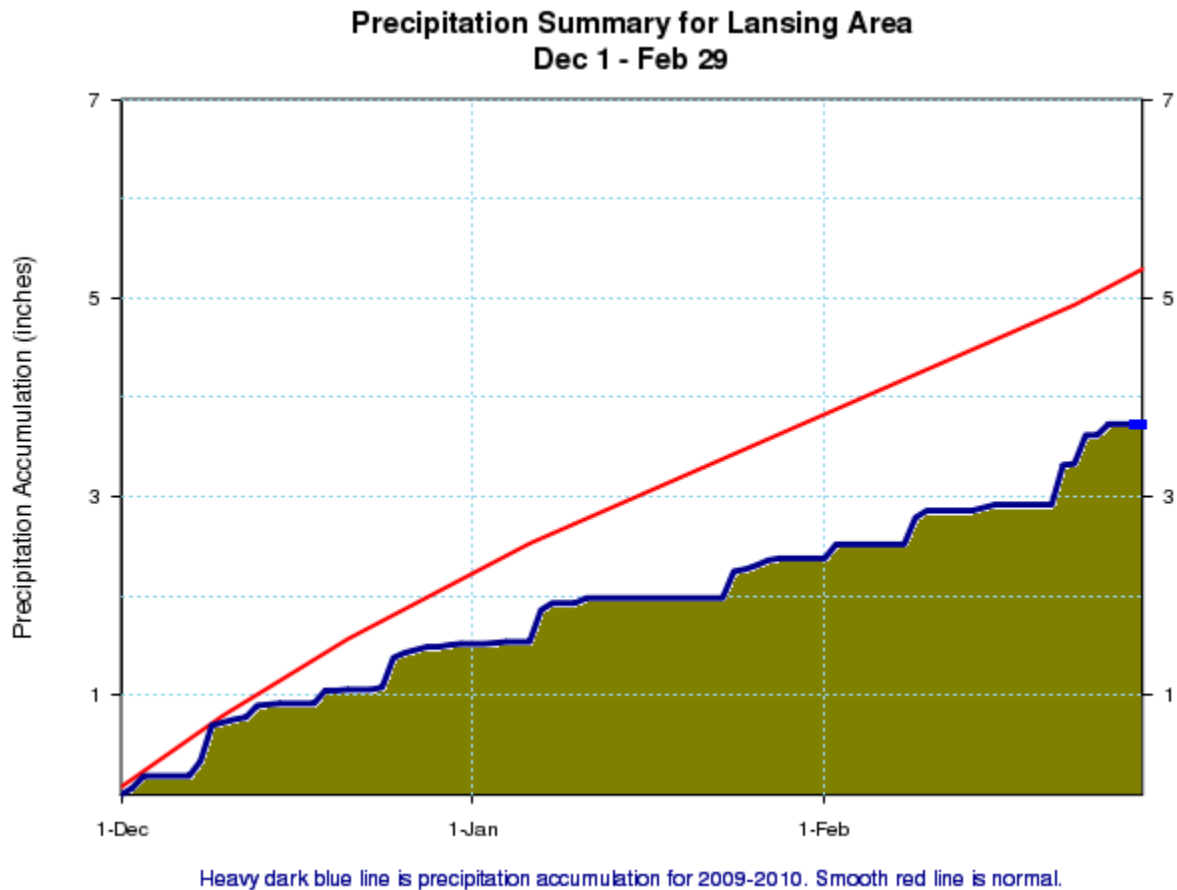
**Figure 17. Grand Rapids daily precipitation accumulation for the winter of 2009/2010.**

Grand Rapids, Lansing and Muskegon all received the heaviest precipitation in December while January and February were very dry months (Figures 17 through 19). Grand Rapids daily accumulated precipitation totals were above normal through most of December. It was only after the first week of January that Grand Rapids fell below normal and stayed there.



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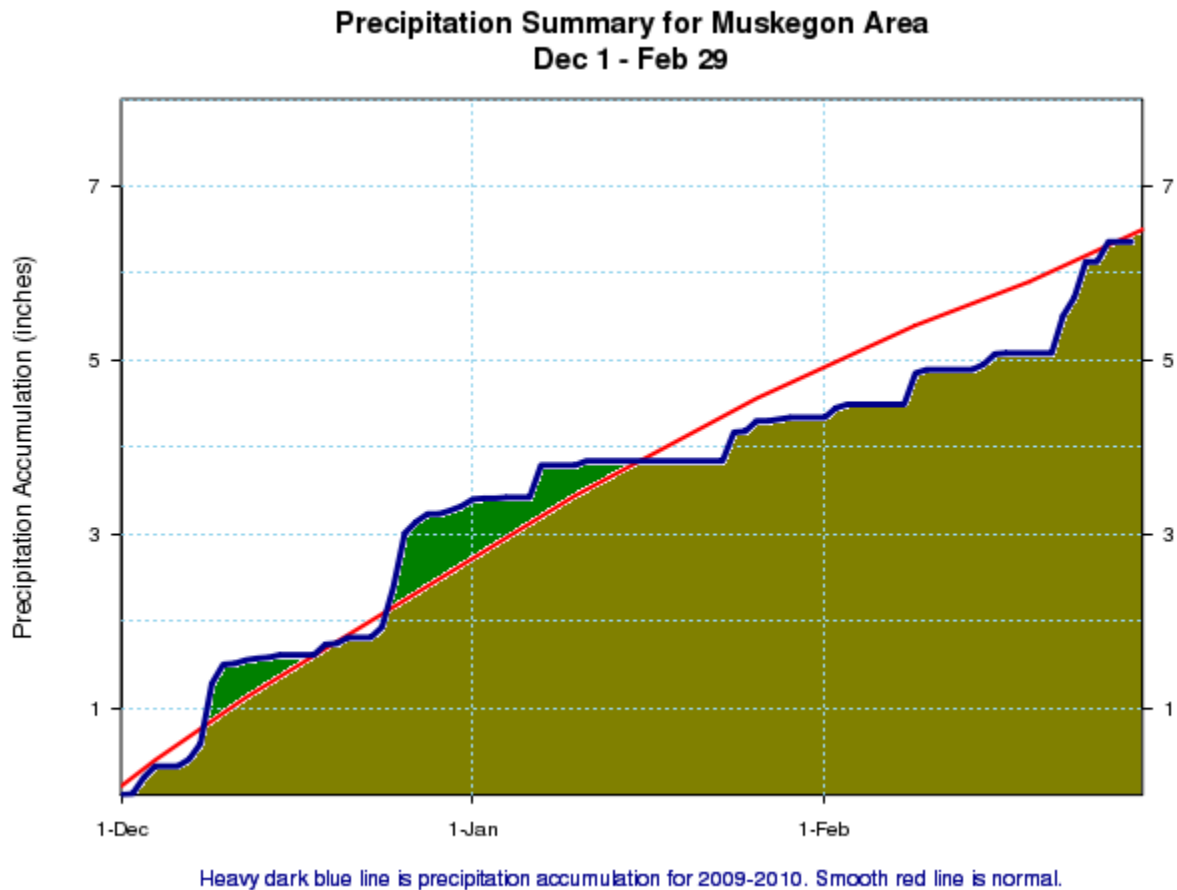


**Figure 18. Lansing daily precipitation accumulation for the winter 2009/2010.**

Lansing did have its wettest winter month in December; however it was not as wet as Grand Rapids, so accumulated precipitation totals did not exceed normal at any point in the winter season.

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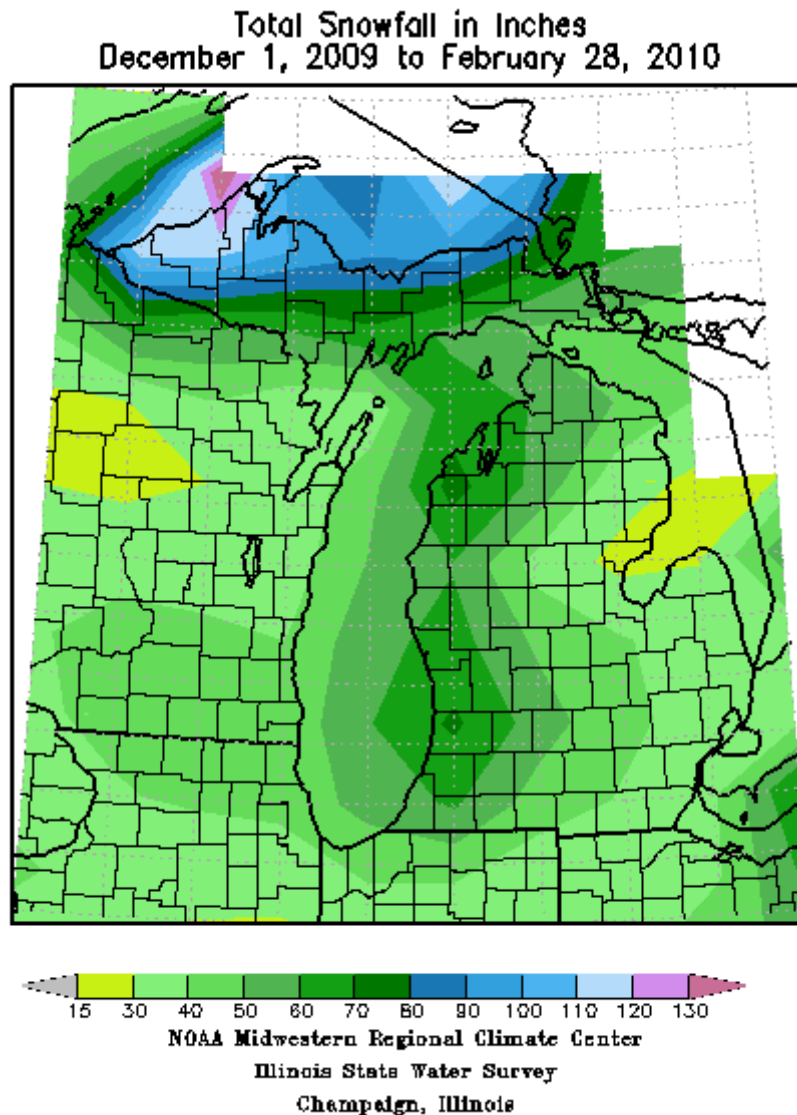


**Figure 19. Muskegon daily precipitation accumulation for the winter of 2009/2010.**

Like Grand Rapids, Muskegon's daily accumulated precipitation was wetter than normal through most of December, but by mid January had fallen below normal. Once the total precipitation fell below normal in mid January it remained below normal through the rest of the winter.

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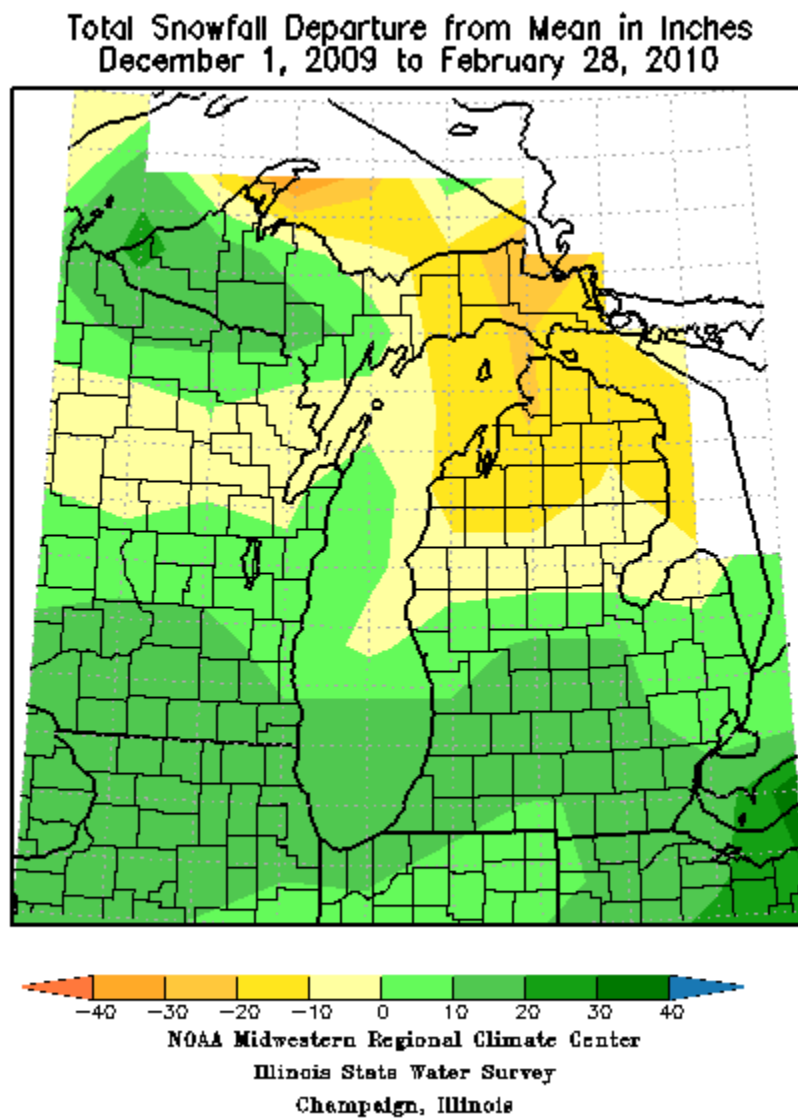


**Figure 20. Winter snow total for Michigan.**

Winter snowfall ranged from around 80 inches near South Haven to under 30 inches over eastern Clare County (Figure 20). Seasonal snowfall was above normal for the winter months of December through February (Figure 21). Snowfall was above normal south of Route 10, but near normal along and north of Route 10. This snowfall pattern was not consistent with the typical El Niño pattern (Figure 22), which features below normal snowfall across just about all of the northern border states from Michigan to the state of Washington.

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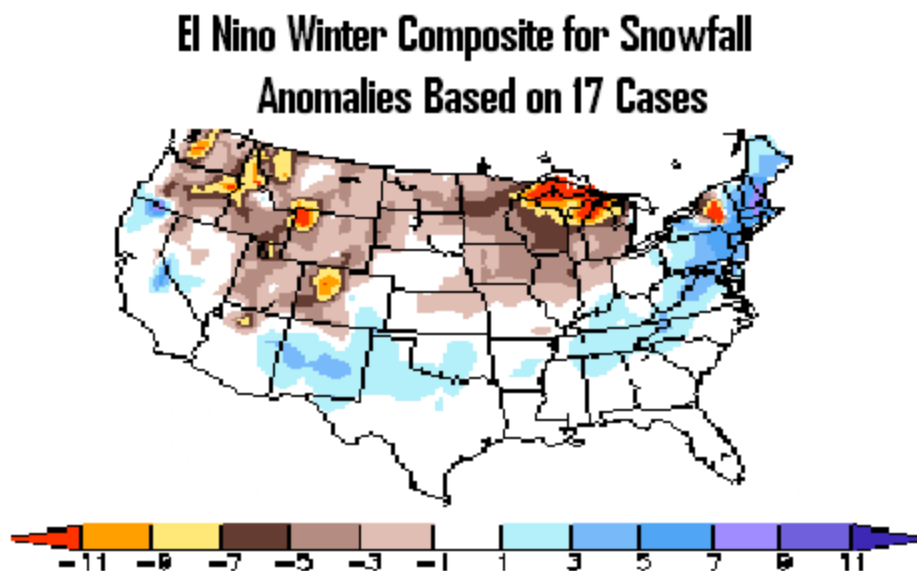
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**Figure 21. Winter total snowfall departure from normal.**

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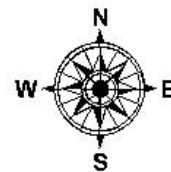
**Figure 22. El Niño winter composite for snowfall based on 17 El Niño events since 1950.**

Total snowfall for the 2009/2010 Grand Rapids CWA can be seen in greater detail in Figure 23. As expected with the lake effect contribution, the heaviest snowfall was west of US-131.

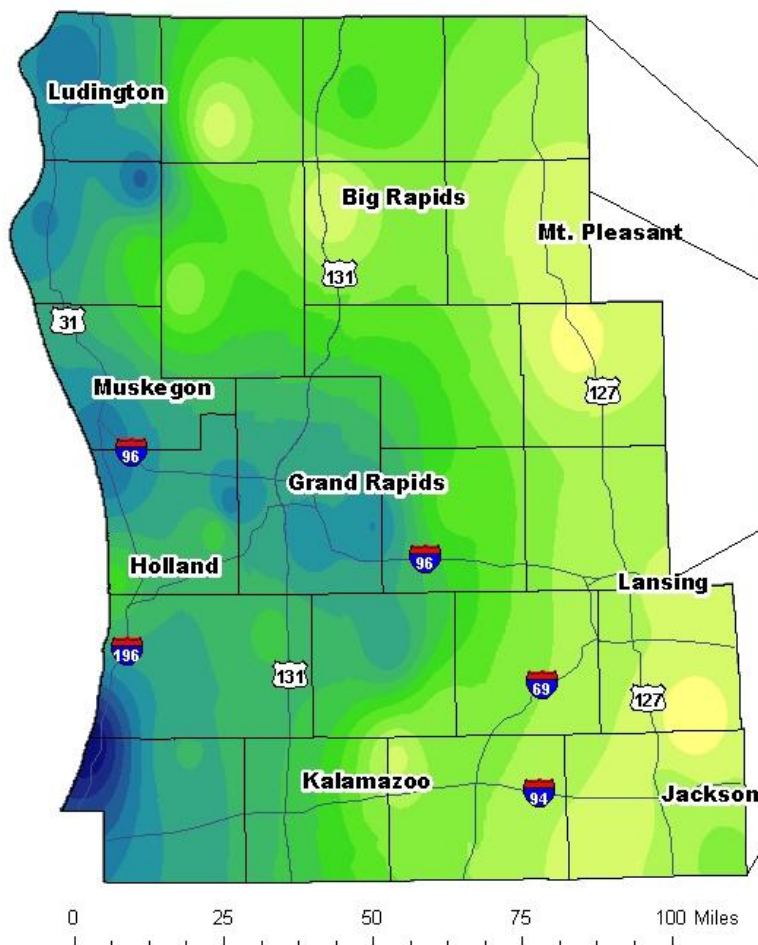
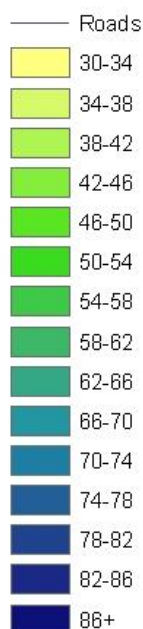
# Winter 2009/2010 Climate Summary For Southwest Lower Michigan



## Seasonal Snowfall: Dec 2009 - February 2010



### Snowfall (inches)



\*Note: Snow map displays approximate snowfall. Local variations are possible.

**Figure 23. Seasonal snowfall from December 2009 through February 2010**

For more details on the individual precipitation events, please see the monthly weather summaries listed below:

December 2009: <http://www.crh.noaa.gov/images/grr/climate/CS200912.pdf>

January 2010: <http://www.crh.noaa.gov/images/grr/climate/CS201001.pdf>

February 2010: <http://www.crh.noaa.gov/images/grr/climate/CS201002.pdf>